EVALUATION OF "CONCRETE MOBILE"

Final Report

The planned work for Research Project 19503-762504-645185, "Evaluation of Concrete Mobile" has been completed, and the results are reported herein.

The work consisted of determining the uniformity and suitability of concrete produced by a continuous type of concrete batcher and mixer known as a "Concrete Mobile."

The Machine

The Concrete Mobile is a truck-mounted batcher-mixer unit with separate bins for coarse and fine aggregate and cement, also tanks for water and admixtures. A speed controlled belt delivers discharge from the bins to a pug type mixer mounted at the rear. Water and admixtures are added as the materials enter the mixing area. Cement is measured onto the belt by a metered device not unlike a water wheel. Aggregate quantities are controlled by opening or closing gages on the bin feed. Vibrators attached to the various bins are intended to supply a uniform feed of materials to the travelling unit. Since the cement feed is constant, different cement contents are accomplished by varying aggregate and water feeds.

The indicated advantages of the Concrete Mobile are, first, to provide small quantities of freshly mixed concrete over a long period of time, or second, to act as an onsite mixer in remote areas. The machines have an integral capacity of six or eight yards, but can be operated to produce large quantities by reloading bins while the mixing operation progresses.

Evaluation Program

The radical nature of the "Concrete Mobile" as compared to conventional transitmix trucks aroused concern for its ability to provide concrete of an adequately uniform quality. The present Division of Highways specifications provide a means

of measuring uniformity of consistency and coarse aggregate distribution. To determine the uniformity of cement distribution, however, a recently developed adaptation of the Cement Treated Base Titration Analysis (Test Method No. Calif. 338E) was employed. While the latter has no related specification, its use in this instance is appropriate and significant.

Compressive strength of cylinders made at intervals of discharge is also included as a measurement of uniformity, but its value is diminished by the relatively small quantities involved.

Test Procedure

Arrangements were made to rent a Concrete Mobile with two operators and to pay for materials used as necessary for the evaluation program.

The owner was first required to demonstrate the calibration of the feed meter and its ability to meter materials in the proportions of a provided mix design. This was accomplished by removing the mixer and discharge chute and metering ingredients one at a time into a container that was subsequently weighed. Appropriate dial settings and meter readings for a 6-sack and a 7-1/2-sack mix design were determined. These settings are normally determined by applying dry rodded unit weights to charts provided by the manufacturer. Cement, as previously stated, is supposedly delivered at a constant rate established by the manufacturer, but variations in the flow characteristics in cements necessitates frequent calibration checks in the field.

Accuracy of unit weight determinations, moisture content of aggregate, and flow characteristics of aggregate and cement all have an effect on the calibration of the machine and do not appear adequately controlled by using the manufacturer's charts. However, the next step in our evaluation will provide an indication of settings whcih are grossly in error.

Once the proper dial settings were established and the correct meter reading per unit of volume was determined, concrete was produced and observed. The accuracy of the volume calibration was determined by metering the amount claimed to be 1/4-cubic yard into a box of measured volume of 1/4-cubic yard. When struck off level, there was an excess of less than a shovelful.

Mixing was continued, and four samples of the 6-sack mix and three samples of the 7-1/2-sack mix were taken at approximately 1-yard intervals. These samples were tested for consistency, coarse aggregate content, unit weight, air content, and cement content by the titration method. It was noted immediately that the brief mixing period (10-12 seconds) aggravated any false set tendencies of the cement, however slight. This is demonstrated by the two final samples on which penetration was measured after the normal 2-minute delay and again after a 4-minute delay with a resulting decrease in penetration.

The cement content determinations on the 6-sack concrete were unfortunately made with improperly proportioned acid and were invalid. The determinations on the mix designed to contain 7-1/2 sacks per cubic yard are felt to be valid and accurate.

Cylinders for compressive strength were made from each sample, and were tested at ages of 14 and 28 days.

Two-inch cubes were fabricated from mortar passing a No. 4 sieve from each sample, and were tested for compressive strength at age 7 days.

Results

Table 1 shows data obtained from field tests on the fresh concrete.

Table 1

Physical Properties of Fresh Concrete

Sample Number	Penetration, Inches 2 Min.	4 Min.	Air Content (%)	Unit Weight (lbs./CF)	Coarse Aggregate (Lbs./CF)	Cement Content (Sks/Yd.)
1	1/4		2.0	149.0	61.7	
2	1/4		2.4	148.2	55.5	
3	3-1/4		1.1	148.2	65.3	
4	2-1/2		1.3	148.8	68.0	
5	3/4		1.6	149.2	66.1	7.58
6	3	1-1/4	1.3	148.4	64.5	7.08
7	1-1/4	1	1.3	148.7	66.6	7.68

Compressive strength data is shown in Table 2. Field specimens were cured one day in molds on site and moved to the moist room until test age.

Table 2

Compressive Strength

Sample Number	Nominal Cement Factor, Sks./CY	7-day Mortar Cubes, PSI	14-day Cylinders PSI	28-day Cylinders PSI
1	6	5750		
2	6	5900	4050	4875
3	6	4530	3620	4475
4	6	5430	4020	4920
5	7-1/2	8100	5180	5990
6	7-1/2	7050	4800	5705
7	7-1/2	8200	5110	5610
Control:				
1*	7-1/2		4675	5345
2*	7-1/2		4845	5720

* Mixed and fabricated in laboratory using mix design in Samples 5, 6, and 7.

Discussion of Test Results

Variations in test results are for the most part, acceptable. Problems were, however, encountered on water control resulting in widely varying penetration measurements. This was due in part to premature stiffening of the cement and in part to a very unsatisfactory valve on the water supply. The valve can be corrected, but the problem of false set is going to be a continuing one with some cements.

Unit weight measurements and variations in weight of coarse aggregate are quite acceptable with the exception of Sample No. 2, and are comparable to concrete produced by conventional mixers.

The three measurements of cement content appear to have an unacceptable spread. However, a comparable spread was found when this test was applied to conventional transit mix concrete. More experience with this test is needed to determine acceptable limits.